Dissertation on

EVALUATION OF DIAGNOSTIC AIDS IN EMERGENCY SURGICAL MANAGEMENT OF ABDOMINO-PELVIC INJURIES

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CERTIFICATE

This is to certify that this dissertation on **"EVALUATION OF DIAGNOSTIC AIDS IN EMERGENCY SURGICAL MANAGEMENT OF ABDOMINO-PELVIC INJURIES"** presented herein by **Dr.M.UMA MAHESHWARAN**, is the original work done in the Department of General Surgery, Government Stanley Medical College and Hospitals, Chennai in partial fulfillment of regulations of the The Tamilnadu DR.M.G.R. Medical University, Chennai for the award of M.S.(General Surgery), under guidance and supervision during the academic period of 2003 - 2006

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DECLARATION

I, **DR.M.UMA MAHESHWARAN** , solemnly declare that this dissertation, titled **" EVALUATION OF DIAGNOSTIC AIDS IN THE EMERGENCY SURGICAL MANAGEMENT OF ABDOMINO-PELVIC INJURIES"** is a bonafide record of work done by me in the Department of General Surgery, Government Stanley Medical College and Hospitals, Chennai under the guidance of **DR.D.R.GUNASEKARAN, M.S.,** Prof. & Head of surgery department, Government Stanley Medical College and Hospitals, Chennai-1.

This dissertation is submitted to The Tamilnadu DR.M.G.R. Medical University, Chennai in partial fulfillment of regulations for the award of M.S.branch I(General Surgery) examination to be held in September 2006.

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CONTENTS

Introduction

Abdomino – pelvic trauma accounts for a large fraction of tragic loss of life and continues to be a distressingly frequent cause of preventable death in the 20 – 40 years age group.

Civilian trauma remains one of the most important public health problems in both developed and developing countries. The abdomen is the third most commonly injured body region. Majority of the abdominal injuries are due to blunt abdominal trauma.

The age of industrialization and modernization has created a new epidemic , which is increasing steadily and posing a new challenge in the diagnosis and management of abdominal trauma. Another misleading factor in diagnosis often not recognized is that relatively trivial injuries may cause significant morbidity and mortality.

The following study presents an overview of abdominal trauma patients admitted and treated in Government Stanley Hospital during the period between January 2004 to march 2006 .

Aim of the Study

AIM OF THE STUDY

1 . To study the cases of both blunt and penetrating abdominal injuries admitted and treated in Government Stanley Hospital.

2. To find out the value and usefulness of various diagnostic modalities in the emergency surgical management of both blunt and penetrating abdomino-pelvic injuries.

3. To find out the incidence of organs involved in both blunt and penetrating abdomino-pelvic injuries separately.

4. To find out the age and sex incidence of in abdominal injuries.

5. To correlate the current study with other studies.

Materials and Methods

MATERIALS AND METHODS

This study on abdominal trauma is based on the **analysis of 61 cases**

that were admitted during the period **between January 2004 and march 2006**.

This study holds in it 51 males and 10 females and covers a wide range of age group right from paediatric to adult age group.

All these cases are medico-legal cases admitted in Government Stanley Hospital under various surgical units.

The patients with abdominal trauma are investigated by routine means like blood analysis , urine analysis and skiagrams prior to surgery. All the cases are taken for surgery based on physical findings and diagnostic abdominal paracentesis alone.

Some patients are investigated with Ultrasound and CT scan . An antibiotic coverage is given . Through a laparotomy the organs injured are identified and treatment is given accordingly.

Review of Literature

REVIEW OF LITERATURE

For evaluation purposes the abdomen is divided into four areas :

1. Intra-thoracic

2. True abdomen

3. Pelvic abdomen

4. Retroperitoneal abdomen

Intra thoracic abdomen : lies beneath the rib cage.

Contents: diaphragm, liver, spleen ,stomach

Pelvic abdomen : lies in the hollow of pelvis.

Contents: rectum, bladder, urethra and small bowel.

In females-uterus, tubes and ovaries.

Retroperitoneal abdomen :

Contents : kidney,ureter, pancreas, II&III portions of

duodenum, Great vessels.

True abdomen :

Small and large bowel, distended bladder, gravid uterus.

Each of the four distinct anatomical areas must be suspected of sustaining injury and must be investigated systematically.

Classification of injuries

It is most useful to categorize injuries into blunt and penetrating as this correlates best with likelihood of significant intra abdominal injury, the speed with which diagnosis and treatment must be accomplished.

Mechanism of injuries

Blunt injuries are thought to result from a combination of crushing, deforming and shearing forces. The magnitude of these forces is directly related to the mass of the

objects involved, rate of the acceleration and deceleration and their relative direction of impact. Injury results when the sum of these forces exceeds the cohesive strength of the tissues and organs involved . Sudden application of the pressure to abdomen is more likely to rupture a solid organ than a hollow viscus.

In **penetrating trauma**, injuries are produced by crushing and separation of tissues along the path of penetrating objects. The clinical consequences of penetrating trauma depend of both energy transfer and local damage. Several **factors affect** the degree of energy transferred to the tissues surrounding the tract of the weapon.

- The kinetic energy of the weapon or missile
- The mean penetrating area
- The weapon or missile's tendency to deform and fragment
- Density of tissues
- Mechanical characteristics of the tissue

With high energy transfer, neighbouring tissue are pushed away from the missile tract and a temporary cavity is created. This lasts only a few milliseconds and it can reach 30-40 times the diameter of the missile. As the enegy waves dissipate, the tissues rapidly retract to a permanent cavity formed by the immediate destruction of tissues. The cavitation depends on rate of energy dissipation, organ density and elasticity.

Injury patterns

Various traumatic insults will produce similar patterns of organ specific injury. An understanding of these patterns and factors that influence their presentation is

helpful in the evaluation and treatment of multisytem injured patients.

BLUNT INJURY ABDOMEN - INJURY PATTERNS

Direct impact injuries	**Associated regional injuries**
Lower right rib fracture	Liver disruption
Lower left rib fracture	Splenic disruption
Mid epigastric contusion	Duodenal perforation , Pancreatic injury
Lumbar transverse process #	Renal / ureteric injury
Pelvic fracture	Bladder / urethral rupture

PENETRATING ABDOMINAL AND PELVIC INJURIES

The patterns of the injuries depend on the sight of entry.

MOST CONSPICUOUS	***ASSOCIATED INJURIES***
Liver	Diaphragm
Spleen	Diaphragm, Stomach
Stomach	Pancreas, Spleen
Duodenum	Pancreas, IVC, CBD
Rectum	Bladder

PRE-HOSPITAL CARE

Little can be done for patients with abdominal injuries in the field. General

features of **stabilization and evaluation** include - to secure adequate airway, inserting IV lines and beginning of fluid resuscitations. **For penetrating wounds**, sterile dressing should be applied. Any foreign body embedded in the wound should not be removed as major bleeding might follow. Evisceration is best left undisturbed except to apply sterile dressing and protect from injury.

HOSPITAL CARE AND DIAGNOSIS

The **history** as well as the **clinical examination** remains important factors in evaluating the patient.

- Injury to lower left chest with rib fracture - 20 % chance of splenic injury.
- Injury to lower right chest with rib fracture - 10 % chance of liver injury.
- Of major pelvic fractures 22 - 47 % are associated with abdominal injuries, 50 % have urinary tract problems.
- Back pain with injury to spine - 20 % chance of renal injury.

Sites of referred pain are helpful in diagnosing intraperitoneal injury.

Left shoulder (Kehr's sign) - Splenic injury.

Right shoulder - liver laceration.

A **detailed history** regarding the type of weapon used, the position of assailant is obtained in stab injuries, which may give a clue to the organ involved.

PHYSICAL FINDINGS

The **key objective** of physical diagnosis in abdominal trauma is to identify the need for operation. The precise determination of organ injury is unnecessary. In the

awake, alert, responsive patients with abdominal injury, physical examination and history are quite accurate in predicting the presence of significant visceral injury so additional adjunctive investigations have limited role. **Close observation and frequent re-evaluations** of abdomen is most important. Penetrating wounds should be marked with radio opaque markers and subsequent radiographs taken to delineate the trajectory of the weapon. Frequently seen abdominal findings are:

- Massive intra-peritoneal bleeding may present with shock.
- Small abrasions and ecchymosis represent warning signs of significant abd. injury.
- Posterior ecchymosis should raise the possibility of retroperitoneal injury.
- Halted, laboured breathing may indicate diaphragmatic irritation due to upper abdominal injury.
- Subcutaneous emphysema of abdominal wall is usually the result of intra-thoracic injury, but may also be due to rupture of retroperitoneal duodenum, distal colon and rectum.
- Inspection of perineum and uretheral meatus for blood - possibility of pelvic fracture.
- Suprapubic and lateral pelvic wall tenderness are assessed for pelvic fracture.
- Abdominal Distention: Not sensitive - as 6 liters of abdominal blood can be lost with only a 2 inch increase in abdominal girth.
- **PALPATION** reveals localized tenderness, spasm or rigidity of the abdominal wall. Rebound tenderness indicates significant intra abdominal injury. Abdominal rigidity alone warrants laparotomy in most cases. The presence of an abdominal mass occurs late in the progression of the clinical

picture. It more often represents hematoma of the liver, spleen, mesentery or omentum.

- **PERCUSSION** may reveal tenderness, shifting dullness or obliteration of liver dullness.
- **AUSCULTATION**: Classically the injured abdomen has been described as silent. Peristaltic sounds can be heard both in the presence of intraperitoneal bleeding and following rupture of hollow abdominal organs. Thus reliance upon the presence of peristalsis as assurance that no intra abdominal injury exists is as fallacious and dangerous. However, absence of peristaltic sounds when carefully sought should be given serious consideration. Peristaltic sounds heard in the chest are diagnostic of traumatic diaphragmatic hernia.
- **ADJUVANT METHODS** : ***Local Exploration of wound***

In emergency department with local anaesthesia unequivocally negative wound explorations (30%) can be discharged with local wound care.

- **SINOGRAPHY** :

  Injection of radio opaque contrast material into the wound.

  High incidence of both false +, false - results & no longer recommended.

- **RECTAL AND PELVIC EXAMINATION**

This should never be omitted. Although the presence of emphysema or gross bleedings is rare, pelvis tenderness may be elicited or the presence of fluid in the pelvis detected.

In women vaginal examination and bimanual examination are of great aid in

detecting the presence of pelvic bleeding or injuries to adjacent viscera.

blood in rectum	→	colorectal injury
high riding prostate	→	uretheral tear
absent rectal tone	→	spinal cord Injury

Clinical signs for urinary tract injuries

Inability to void despite full bladder

Blood at the external meatus

Abnormal position of prostate on P/R.

- **INTUBATION**

The Nasogastric tube and the Foley's catheter both serve as important diagnostic and therapeutic aids. Insertion of **Nasogastric tube** permits decompression of stomach and prevents further accumulation of air. The aspirate can also be detected for blood.

After insertion of **Foley's urinary catheter** the urine is examined for blood. A positive test is an indication for a cystogram and intravenous pyelography.

DIAGNOSTIC AIDS

In the awake, alert responsive patients with isolated abdominal injury the physical examination and history are quite accurate in predicting significant visceral injury. Hence additional investigations has a limited role as adjuncts to physical examination.

However drugs, alcohol, injuries of head or spinal cord may complicate physical

examination. Additional diagnostic modalities are of benefit in these groups of patients.

ADJUNCTIVE STUDIES

Laboratory tests of value in the evaluation of a patient with abdominal trauma include haematocrit, urine analysis, and serum amylase. White cell count, serum creatinine, glucose and electrolyte estimations are obtained for the baseline values but have little contribution to early management.

RADIOLOGICAL STUDIES

X-Rays

The basic roentgenographic examination consists of

an upright postero anterior chest roentgenogram,

Antero-posterior supine abdominal film.

Standard approach should be followed in examining roentgenograms.

1. Examine the **skeletal structures** : Fracture of transverse process are associated with retroperitoneal haemorrhage / renal injury. Left side rib fracture with splenic injury. Right side rib fracture with liver injury.
2. Inspect for **free intraperitoneal air** - indicative of a ruptured hollow viscus : Free air may be seen subdiagraphragmatically beneath the lateral abdomen wall on a lateral decubitus film or as the " ***dome sign*** ", "***falciform ligament sign***" or the "***double wall sign***" on a supine film.
3. Classic "***Stippling***" of retro peritoneal air usually indicates rupture of the

retroperitoneal portion of duodenum or recturm.

4. Obliteration of psoas shadow indicates retroperitoneal bleeding.

5. Separation of the gas filled right or left colon from the properitoneal fat line indicating intraperitoneal blood or fluid in the flanks - ***Flank Stripe Sign***.

- About 800 ml of **intraperitoneal blood** is required to be evident on plain X-ray.
  - Floatation of small bowel towards center of abdomen
  - Increased space between loops of bowel
  - General ground glass appearance

6. Enlargement or distortion of the outlines of the spleen, liver or kidneys.

7. ***Hepatic Angle Sign*** : Loss of definition of the usually distinct inferior and right lateral borders of the liver as blood accumulates between the hepatic angle and right peritoneal wall.

8. ***Dog Ear Sign*** : Accumualtion of blood that gravitates between the pelvic viscera and side walls on each side of bladder.

- The **chest radiograph** may aid in the diagnosis of abdominal injuries such as ruptured hemidiaphragm (a nasogastric tube seen in the chest) or pneumoperitoneum.
- The pelvic or chest radiograph can demonstrate fractures of thoraco-lumbar spine.
- The presence of transverse fractures of the vertebral bodies, ie, Chance fractures, suggests a higher likelihood of blunt injuries to the bowel.
- In addition, free intraperitoneal air, or trapped retroperitoneal air from duodenal

perforation, may be seen

CONTRAST STUDIES

Retrograde Urethrography

Diagnostic for uretheral tears if extravasation of dye is seen during injection (Dynamic) or following injection.

Cystogram and / or IntraVenous Urography

- Necessary to evaluate bladder, upper urinary tract problems.

.ULTRASONOGRAM

Bedside ultrasonography is a rapid, portable, noninvasive, and accurateexamination that can be performed by emergency physicians and traumasurgeons to detect hemo – peritoneum. The **FAST (**Focused Abdominal Sonography of Trauma **) examination** has virtually replaced DPL as the procedure of choice in the evaluation of hemodynamically unstable trauma patients.

The **minimum threshold for detecting hemoperitoneum** is unknown and remains a subject of interest. Kawaguchi and colleagues found that 70 ml of blood could be detected, while Tiling et al found that 30 mL is the minimum requirement for detection with ultrasound. They also concluded that a small anechoic stripe in the

Morrison's pouch represents approximately 250 ml of fluid, while 0.5-cm and 1-cm stripes represent approximately 500 mL and 1 L of free fluid, respectively.

An examination is interpreted as **positive if** fluid is found in any of the ***4 acoustic windows*** with the patient supine. These windows are pericardiac, perihepatic, perisplenic, and pelvic (known as the **" *4 Ps* "**).

Is interpreted as **negative** if no fluid is seen. An examination is deemed **indeterminate** if any of the windows cannot be adequately assessed.

Hemodynamically stable patients with positive FAST may require a CT scan to better define the nature and extent of their injuries. Taking every patient with a positive FAST result to the operating room may result in an unacceptably high laparotomy rate.

Hemodynamically stable patients with negative FAST results require close observation, serial abdominal examinations, and a follow-up FAST examination.

However, strongly consider performing a CT scan, especially if the patient is intoxicated or has other associated injuries.

Hemodynamically unstable patients with negative FAST results are a diagnostic challenge to the treating physician. Options include DPL, exploratory laparotomy, and, possibly, a CT scan after aggressive resuscitation.

Ultrasound can demonstrate presence of the free intraperitoneal fluid as well as the extent and precise location of solid organ injuries.

It is **compromised by** the presence of lower rib fractures, extensive skin lesions, soft tissue injuries or dressings, It is less informative in obese patients, those with gas distended intestines, and in patients with severe tenderness and in the assessment of hollow viscus perforation.

CT SCAN

CT is indicated primarily in hemodynamically stable patients who are candidates for non-operative therapy and in those who have unreliable physical examination or other conditions which require CT evaluation.

CT is extremely valuable for retroperitoneal injury, for which DPL is not helpful.

INDICATIONS FOR CT

1. Hemodynamically stable patient with equivocal abdominal examination.
2. Patients with closed head injury and spinal cord injury.
3. Hematuria in the stable patient.
4. Patients with pelvic fractures and significant bleeding.
5. Patients in whom DPL results are equivocal.

6. Patients in whom DPL is difficult to perform.
7. Patients at high risk of retroperitoneal injuries.

LIMITATIONS

1. Need for high quality radiographs / skilled radiologists.
2. Need for proper position.
3. Poor sensitivity for intestinal and pancreatic injuries.
4. Poor correlation between splenic and hepatic CT images and the subsequent risk of bleeding.
5. Should never be considered in hemodynamically unstable patients

The CT scan remains the criterion standard for the detection of solid organ injuries (liver,spleen). In addition, a CT scan of the abdomen can reveal other associated injuries, vertebral and pelvic fractures and injuries in the thorax.

- CT scans, unlike DPL or FAST examinations, have the capability to determine the source of hemorrhage , retroperitoneal injuries
- CT scans provide excellent imaging of the pancreas, duodenum,and genito-urinary system. The images can quantitate the amount of blood in the abdomen and can reveal individual organs with precision.

ANGIOGRAPHY AND RADIONUCLEIDE SCANNING

Have limited role in the early management of a trauma patient and are best left for serial observation during non-operative management of solid organ injury.

1.Aortic Arch : To rule out torn thoracic aorta

2.Renal : In patients with non visualized kidney in IVP and Hematuria.

3.Pelvic : For possible embolisation, for persistent bleeding in pelvic # after external fixator.

INDICATION

Puzzling diagnostic problems, pelvic fractures, suspected aortic transection.

Primary benefit has been in the evaluation of injuries to liver, spleen, kidneys and pancreas when other diagnostic modalities are equivocal and when therapeutic intervention is needed. Radionucleide scans are most helpful in detecting possible splenic injuries in otherwise stable patients.

Technetium sulfur colloid scans have been used to detect splenic injury. It can also be used to detect injury to renal parenchyma. Absence of nephro-toxicity in the presence of marginal renal function is an advantage over IVP.

ABDOMINAL PARACENTESIS

Non clotting blood withdrawn in the syringe is considered a strong evidence of injury, as is air or bile stained fluid. A negative tap has no diagnostic significance.

Procedure requirement

Sterile syringe, 18-20 gauge spinal needle. Mandatory to have the patient void or empty the bladder by catheterization. A four quadrant approach is preferred with the

needle being introduced lateral to the rectus sheath.as little as 0.1 ml of non-clotting blood is sufficient evidence of intra-peritoneal bleeding.

Preferred order of aspiration being left lower quadrant, right lower quadrant, left upper quadrant, right upper quadrant. It is **contraindicated if** peritoneal space is suspected of being extensively involved with adhesions. Sensitivity is 21% only.

DIAGNOSTIC PERITONEAL LAVAGE

DPL was first introduced by Root in 1964. It is the most sensitive test available for determining the presence of intra-abdominal injury.

Procedure:

Bladder should be emptied and a pelvic radiograph should be taken if there is suspicion of pelvic fracture so that the incision can be placed in the supra umbilical region if necessary.

Techniques: open, semi-open, closed.

The ***semiopen technique*** is preferred and it is performed at the infra –umbilical ring because of its relative avascularity, paucity of pre-peritoneal fat there and greater adherence of peritoneum.

The ***closed technique*** can be complicated by perforation of small bowel, mesentry, bladder and retroperitoneal structures. Results of DPL are considered grossly positive if more than 10ml of frank blood is with drawn.

If less than 10 ml is withdrawn, 1 litre of Normal Saline (15 ml/kg in Children) is

instilled and the patient is gently rocked form side to side. The effluent is withdrawn and sent of analysis. A minimum of 75% recovery of lavage effluent is required for the test to be considered valid.The effluent is analysed for RBC,WBC, alkaline phosphatase and amylase.

Criteria for positive DPL

Index Aspirate	**Positive**	**Equivocal**
Blood **Lavage fluid**	>10 ml Enteric contents	
RBC	>100,000/mm3	< 20,000/mm^3
WBC	>500/mm^3	< 500/mm^3
Enzyme	Amylase >20 IU/l Alkaline Phosphatase >3 IU/l	-
Bile	Confirmed biochemically	-

Indications

1. mental obtundation , spinal cord injuries
2. unexplained hypotension
3. high energy transfer with suspected abdominal injury
4. severe chest trauma with fracture of 1st rib.
5. in whom sequential abdominal examination will be impossible.

Absolute contraindication: is an existing indication of laparotomy.

Relative contraindications:

Abdominal distension, gravid uterus, previous abdominal surgery.

Disadvantage

False negative study in the presence of intra-abdominal adhesions.

False positive results can occur in infra- umbilical approach

It does not sample the intact retroperitoneum

may not adequately reflect isolated hollow visceral or diaphragmatic perforation.

Negative DPL doesn't mean that there is no intra abdominal injury.

RBC count 50,000-1,00,000/mm^3 $\rightarrow$ visceral damage 5%.

DIAGNOSTIC LAPAROSCOPY

Allows direct examination of abdominal contents. The major limitation is performing a comprehensive examination of entire abdomen and pelvis particularly the posterior recess and retroperitoneum.

The disadvantages are requirement of general anaesthesia and pneumoperitoneum.

If the trajectory is not tangential, gasless laparoscopy can be used.

Contraindicated in

suspected diaphragmatic injury - risk of tension pneumothorax.

injuries to major blood vessels - risk of air embolism.

SPECIFIC ORGAN INJURIES

DIAPHRAGMATIC INJURIES

Diaphragm can be injured as a result of either blunt or penetrating trauma. Penetrating injuries below the level of nipples have incidence 30%.

Following blunt trauma, it is involved in 3% of cases mostly on the left side. The tears usually extend from the tendon to the lateral and posterior direction.

Organs commonly associated with diaphragmatic injuries are stomach, spleen and liver. Isolated diaphragmatic injury is very rare.

MECHANISM OF INJURY:

1. compressing forces on the abdomen causing abdomino-thoracic pressure gradient augmented by the gasp reflex.
2. shearing forces of chest compression.
3. congential areas or weakness in diaphragm especially in the left posterolateral area.

DIAPHRAGM INJURY SCALE

Grade	Injury description
I	Contusion
II	Laceration <2cm
III	Laceration2-10cm
IV	Laceration >10cm with tissue loss<25 cm2
V	Laceration with tissue loss>25 cm2

- advance one grade for bilateral injuries upto grade III

The **diagnosis** is suspected in any thoraco-abdominal imjury.

Physical findings vary from asymptomatic to life threatening Cardio –pulmonary instability owing to herniation of visceral contents into the chest.

- A **chest X-ray** may show mediastinal shift towards oppostic side with an ipsilateral opacity if it is solid viscera, or gas shadow if hollow viscera.
- **Pleuro-peritoneal lavage** by which balanced salt solution gravitated into the peritoneal cavity is recorded through an intercostals drainage tube.

MANAGEMENT :

After injuries to the viscera in the adjacent cavities are dealt with, diaphragmatic injury is repaired with non-absorbable sutures. If there is loss of substance, then plastic repair is done.

The complications of diaphragmatic injury results primarily from missing the injury and presentation later with incarceration and strangulation of bowel..

If the injury is detected after 4 weeks it should be repaired through a thoracotomy so that adhesions to the lung and pleura can be lysed.

ABDOMINAL ESOPHAGUS

It is seen rarely in abdominal trauma injuries. Should be adequately debrided and repaired in 2 layers over a nasogastric tube or dilator. In addition , repair should be buttressed with full thickness diaphragmatic pedicle flap, thal fundal patch, or a nissen's fundoplication. A nasogastic tube is always left in place until a barium esophagogram is performed after 10-14 days. If a small leak is present serial esophagogram should be performed until it resolves.

GASTRIC INJURIES

Gastric injuries are commonly involved in penetrating abdominal injuries. In blunt injury it is involved in 0.9-1.7%. The lower costal margin, left lobe of liver, transverse colon protects the stomach from blunt injury. In blunt trauma mechanism of injury is mainly due to increased tension and distension from a full stomach.

- Blunt trauma involves - lesser curve and anterior surface Commonly.

- In children greater curve is commonly involved.
- In penetrating injuries fundus and body of stomach are mostly involved.

Type of injury varies from focal laceration to massive transmural necrosis.

In injury the sero-muscular layer gives way first and then mucosa and submucosa.

Diagnostic adjuvants are unfortunately unreliable in detection of injuries.

MANAGEMENT

- Any laceration is closed in 2 layers with absorbable inner layer and non-absorbable outer layer. Injuries to any vessels suppling to the stomach may be ligated with impunity.
- A gastric drainage procedure should be performed for injuries along the lesser curve when vagus nerve has been damaged.
- For extensive injuries, gastric resection may be required.

COMPLICATIONS

Intra abdominal abscess, gastric fistula, disruption of repair, empyema, hemorrhage and obstruction.

SPLENIC INJURIES

The spleen is the most common organ involved in blunt trauma. Missed splenic injury is the most common cause of preventable death in trauma patients.

MECHANISM OF INJURY

During increased intra-abdominal pressure following blunt trauma compression of spleen may occur between anterior abdominal wall and the posterior rib cage.

Injury to spleen is suspected when there is history of penetrating injury to lower chest or upper torso. The diagnosis of splenic injury in abdominal trauma is done on the basis of clinical examination in majority of patients.

Besides presenting as emergency it may manifest as **delayed** presentation first described by **Baudet** due to clot lysis, usually occurring 10-14 days after initial injury.

PHYSICAL FINDINGS

Kehr's sign : pain referred to left shoulder due to irritation of diaphragm

Balance sign : persistent dullness due to early coagulation of splenic blood

Saegesser's splenic point : Tenderness point in the lower posterior triangle between left sternomastoid and scalenus medius above clavicle.

X-RAYS MAY SHOW

1. Loss of normal splenic shadow
2. Serration of the greater curvature of stomach
3. Medical displacement of gastric air bubble
4. Obscuration of left psoas shadow
5. elevated left hemidiaphragm
6. downward displacement of splenic flexure of colon

DPL is highly sensitive but this is invasive and nonspecific.

USG can detect free blood in the peritoneum but it may not detect splenic injuries which is not actively bleeding.

CT is useful - In stable patients

SPLEEN INJURY SCALE

Grade	Injury	Description
I	Haematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, < 1cm parenchymal depth
II	Haematoma	Subcapsular, 10%-50%surface area: intraparenchymal <5 cm in diameter
	Laceration	Capsular tear 1-3 cm parenchymal depth which does not involve a trabecular vessel
III	Haematoma	Subcapsular, 50% surface area or expanding; ruptured subcapsular or parenchymal haematoma; Intra parenchymal Haematoma; > 5cm or expanding
	Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% or spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury which devascularizes spleen

MANAGEMENT

Grade I : often require no treatment

Grade II : topical haemostatic agents are usually effective in control bleeding from these injuries. For continuing bleed - Splenorraphy is considered.

Grade III : splenorraphy with vicryl or key hole mesh or buttress of omentum

Grade IV : partial splenectomy

Grade V : splenectomy

Splenectomy is also done in patients with haemodynamic instability in severe associated injuries.

Splenic conservation

Current recommendations for splenic conservation are patients with splenic injuries detected by CT, if they are haemodynamically stable and have no other injuries that would require celiotomy.The success rate in adultsis 65%. But there is a risk of missing other abdominal injuries in 30%.

Surgical adjuncts for splenic salvage includes.

- TOPICAL AGENTS

  Fibrin glue , Thrombin soaked , Microfibrillar collagen

- WRAPS AND BUTTRESSES

  Omentum , Vicryl mesh , Gel foam , Teflon pledget

- CAUTERY AND DISSECTORS

  Electro-cautery , CUSA , Argon beam coagulator

COMPLICATIONS

With the exception of ongoing hemorrhage in acute injury, Overwhelming post splenectomy infection (OPSI) is one of the important complication - which is rare, occurring in 0.3% adults.

LIVER INJURIES

Liver being the largest organ ,can be easily injured in abdominal trauma. The incidence in penetrating injury exceeds that of blunt trauma. In blunt trauma, depending on the haemodynamic stability ancillary investigation can be done.

LIVER INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hamatoma	Subcapsular , < 10% surface area
	Laceration	Capsular tear, < 1 cm parenchmal depth
II	Hamatoma	Subcapsular , 10 – 50 % surface area Intraparenchmal , < 10cm diameter
	Laceration	Capsular tear, 1-3cm parenchmal depth, < 10cm length
III	Hamatoma	Subcapsular , 50 % surface area or expanding Ruptured subcapsular / parenchmal hematoma Intraparenchymal hematoma >10cm or expanding
	Laceration	> 3 cm parenchymal depth
IV	Laceration	Parenchymal disruption inv. 25-75 % of hepatic lobe or 1-3 couinaud's segments within a single lobe
V	Laceration	Parenchymal disruption inv. > 75 % of hepatic lobe Or > 3 couinaud's segments within a single lobe
	vascular	Juxtahepatic venous injuries i.e., retrohepetic vena cava / central hepatic veins
	vascular	Hepatic avulsion

MANAGEMENT

In penetrating trauma most trauma surgeons continue to explore the patients

In blunt trauma there is role for **non-operative management** guided by CT scan.

1. Patients must be haemodynamically stable and have no other clinical indication for laparotomy.
2. Injury limited to liver as interpreted by CT, contained intrahepatic haematoma or estimated intraperitoneal blood loss of less than 250 ml.

3. The patients must be monitored closely for bleeding or other complications in an ICU set up.

Most blunt lacerations occur along segmental fissures because vascular and biliary ductal structures are moderately resistant.

Grade I: no specific treatment

Grade II: options available are packing., manual compression.

If **bleeding recurs** ,

it can be - cauterized, or by haemostatic agents or with absorbable sutures. fibrin glue, Argon beam coagulator, Pringle Manoeuvre , finger fracture technique, Selective hepatic artery ligation

GRADE III ,IV,V INJURIES - TREATMENT ALGORITHM

Exploration of liver injury with direct control of bleeding ➲ Pringle Manoeuvre ➲ Finger fracture / direct ligation / tractotomy ➲ Direct management / atrio – caval shunt ➲ Liver packing & planned re-exploration.

The options available following **REBLEED** are :

1) Omental pedicle graft
2) Meshwrap or rubber drain tourniquet
3) Selective angiographic embolization
4) The final resort (in few centers) is transplantation for irreparable injuries

Some of the **complications** after liver injuries are

- Coagulopathy ,Re-bleeding , Infections

- Haemobilia, Biliary fistula

PORTA HEPATIS

Virtually all portal triad injuries occur in association with injury to the liver, duodenum or associated organs.

A Pringle's maneuver allows isolation of the structures of porta hepatis and determination of the nature of injury.

Repair of vascular structures take precedence over biliary structures.

EXTRAHEPATIC BILIARY TREE INJURY SCALE

GRADE	DESCRIPTION
I	Gall bladder contusion / hematoma Portal triad contusion / hematoma
II	Partial gall bladder avulsion from liver bed Cystic duct laceration , GB perforation
III	Complete gall bladder avulsion from liver Cystic duct laceration
IV	Partial / complete Rt. / Lt. Hep duct laceration Partial common Hep. duct laceration < 50 % Partial CBD laceration < 50 %
V	> 50 % transsection of CHD/CBD

PORTAL VEIN

Lateral venorrhaphy with 5-0 prolene is done for tangential **partial laceration**.

Options for large lacerations/complete **transection** include :

- Ligation, resection with end to end anastomosis, interposition grafting with jugular/ splenic vein or gortex graft, portosystemic shunting. Ligation in a patient with massive liver injury, hypotension and multiple blood transfusion has an unacceptably high mortality rate.

HEPATIC ARTERY

Injury to a branch of hepatic artery- ligation is preferred .

Injury to hepatic artery proper- repair is attempted.

If repair is difficult - ligation should be performed.

In patients with cirrhosis/preexisting liver disease, hepatic artery ligation results in hepatic infarction. Hence every effort should be made to repair the hepatic artery. When the patient has combined injury of the hepatic artery and portal vein-ligate the artery and attempt portal vein repair.

CBD

The most important **factor in determining management** of CBD is whether the duct is completely or incompletely transected.

- Incompletely transected (<50%) - primary repair over a T- tube
- Injuries involving >50% of circumference - biliary enteric anastosmosis
- Unstable patients - ligation of small Biliary radicles is acceptable.

GALL BLADDER

Even with minimal injuries the gall bladder is non-functional and may become inflamed unless it is removed. Cholecystectomy is the procedure of choice for severe contusion/ avulsion injuries to the gall bladder.

DUODENAL TRAUMA

- Duodenal injuries account for 4% of abdominal injuries.

- Commonly seen in penetration injuries.
- Blunt injury most commonly involves the 2nd and 3rd part of duodenum.
- Penetrating injury commonly involves the second part.

The first part is relatively mobile, so blunt trauma results in traction tears.

MECHANISM OF INJURY

The second part is relatively fixed and injury to this is caused by the closed loop bursting between the pylorus and DJ flexure which is fixed by ligament of trietz.

The third and fourth part injuries are due to shearing forces against spine.

Blunt duodenal injuries are most difficult to diagnose in the early stages.

In penetrating injuries this is usually made at operation.

X-ray findings that may indicate duodenal injuries are - (usually normal)

free intra peritoneal air, air in the periduodenal tissue especially in right perinephric region and along the right psoas muscle with increase in time it may ascend to mediastinum. Scoliosis concave to the right, obliteration of right psoas shadow

DUODENUM INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hematoma	Involves single portion of duodenum
	Laceration	Partial thickness , no perforation
II	Hematoma	Involves > one portion
	Laceration	Disruption < 50% of circumference of D2
III	Laceration	Disruption 50 – 75 % of circumference of D2

		Disruption 50 – 100 % of circumference of D1/D3/D4
IV	Laceration	Disruption > 75% of circumference of D2
V	Laceration Vascular	massive disruption of duodeno-pancreatic complx Devascularisation of duodenum

- **DPL** has minimal role in detecting duodenal injuries.

- **Upper GI series** using water soluble contrast is useful.

- **CT scan** has proven to be capable of detecting retro peritoneal rupture with intra – luminal and IV contrast. It may be the investigation of choice is stable patients.

- **Operative findings** that may rise suspicion of duodenal injury includes, periduodenal crepitation, bile staining or haematoma.

  - In the presence of such findings duodenum should be visualized both anteriorly and posteriorly through,

  - Kocher manoeuvre exposing second part
  - Catell-braasch maneuver exposing third part.
  - By dividing the ligament of treitz exposing fourth part.

MANAGEMENT

Most of the injuries are **small perforations** which can be closed in two layers.

With **smaller defects** end to end anastomosis, if tension exists Roux-en-y Duodeno-jejunostomy can be performed.

With **larger defects** splayed jejunal limb split longitudinally in a retrocolic manner and two layer anast is done. Gastric island flap from body of stomach.

Duodenal decompression is done in all cases after repair either by nasogastric tube decompression or by stone and Fabian technique.

For **severe Duodenal Injuries**

1) Berne's duodenal diversion procedure
2) Pyloric exclusion procedure of Vaughn

Duodenal Haematoma

- Usually submucosal in location
- 3% can have occult duodenal perforation
- Coiled spring deformity in upper GI series
- Conservative management
- If found obstructing the duodenum at the time of laporatomy, should be evacuated through a seromuscular incision.If not possible a GJ should be done.

INTESTINAL TRAUMA

Small bowel is most commonly injured in penetrating trauma and third most common injured organ in blunt trauma.

It is involved in 80% of gunshot wounds and 30% of stab wounds.

In blunt injury,shearing mechanism produced during sudden deceleration produces injuries to small bowel, from fixed points of attachment,

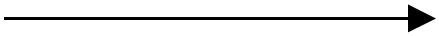
ligament of treitz and near the ileocaecal valce.

Bursting of fluid loops of small bowel in response to a sudden increase in intra abdominal pressure.

Direct force against abdomen can crush the intestine against spinal column.

SMALL BOWEL INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hematoma	contusion / hematoma without devascularisation
	Laceration	Partial thickness , no perforation
II	Laceration	Laceration < 50% of circumference
III	Laceration	Laceration > 50% of circumference
IV	Laceration	Transection small bowel
V	Laceration	Transection small bowel with segmental tissue loss
	Vascular	devascularisation of segment



In haemodynamically unstable patients with signs of peritonitis, laparotomy is proceeded with immediately.

In haemodynamically stable patients with penetrating injury the wound is explored locally, if there is breach in the peritoneum, laparotomy is done.

X-rays may show air under diaphragm in only 33% of cases.

The value of DPL in small bowel injuries is questionable.

In CT, which has low sensitivity bowel wall thickness, perivisceral fluid, and small pockets of air may be seen.

Diagnostic gasless laporoscopy can be useful when the penetrating wound is not tangential.

Small perforations can be closed primarily in the two layers with interrupted sutures. Transverse tears closed longitudinally and vice versa.

The **criteria for small intestinal resection** are:

1. Injuries that cannot be closed without excessive narrowing of lumen
2. Large, irregular wounds
3. Short segments containing multiple perforations
4. Areas that are infarcted or crushed.

PANCREATIC INJURY

Pancreatic trauma is relatively uncommon, accounting for less than 10%of all abdominal injuries. Although the pancreas is relatively protected in the retroperitoneum the increasing frequency of high speed motor vehicle accidents has contributed to an increasing incidence of pancreatic injury.Because the pancreas is surrounded by major abdominal organs and blood vessels, associated injuries are common and they influence

the morbidity and mortality.

The key determinant of long term outcome is the presence or absence of pancreatic duct injury as most post-operative complications can be attributed to inadequate control of major duct disruption.

Since a significant proportion of pancreatic trauma have associated intra-abdominal injuries, clear-cut indications for laparotomy frequently exists.

In contrast, identifying a pancreatic injury in the absence of other indications for laparotomy is challenging.

- Serum amylase – limited sensitivity and specificity.
- Diastase in 2 hour urine collection is a reliable index of pancreatic injury.
- Plain X-ray -

  1. loss of psoas shadow, **2**. left pleural effusion

  3. pancreatic phlegmon with displacement of stomach can be seen.
- CT scan is very useful
- ERCP is useful in patients with delayed presentation.
- Most injuries can be diagnosed by careful inspection following adequate exposure.

  Intraoperative USG and endoscopic studies have been suggested as possible means of identifying major ductal injuries.
- Contrast studies are used when there is concern about the integrity of the main pancreatic duct.

PANCREAS INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hematoma	Minor contusion without duct

		injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major contusion without duct injury / tissue loss
	Laceration	Major laceration without duct injury / tissue loss
III	Laceration	Distal transection or parenchymal injury
IV	Laceration	Proximal transection or parenchymal injury involving ampulla
V	Laceration	massive disruption of pancreatic head complex

This system address the key issues of parenchymal disruption and major duct status.

The pancreas to the left of superior mesenteric vessels is considered **distal.**

The **principles in managing pancreatic injuries** are:

1. control of haemorrhage
2. debridement of devitalized tissue
3. provide adequate drainage
4. preserve as much functional pancreatic tissue as possible.

Type I injuries : most common, require only haemostasis and drainage.

Type II injuries : Distal pancreatectomy with or without splenectomy.

Type III injuries : require pancreatectomy distal to duct injury or if the remaining pancreatic tissue is inadequate – preservation of body and tail with a Roux-en Y pancreatico-jejunostomy.

Type IV injuries : management depends on the integrity of distal CBD, the ampulla and the severity of duodenal injury.

- In situations where ampulla and its blood supply is intact, primary repair of duodenal injury is done and pancreatic injury is treated as for I, II, III injuries.

- For massive injuries where ampulla is destroyed or de-vascularization,

- pancreatico-duodenectomy is done.

Complications

1. **pancreatic fistula**- resolves spontaneously if adequate external drainage is provided. Somatostain is useful.
2. **intra abdominal abscess** – prompt surgical debridement and drainage.
3. **pseudocyst** formation
4. **post operative pancreatitis**.

MESENTERIC INJURIES

Common in blunt abdominal trauma. **Linear tear** will not pose a problem, only the **transverse tear** - which may jeopardize the blood supply to the bowel.

Mesenteric haematomas and laceration greater than 2 cm, expanding, uncontained or near the root of mesentery require exploration.

Proximal control must be obtained prior to exploring a mesenteric haematoma. In the distal mesentery digital compression will do.

In proximal haematomas at the root of mesentery, **involvement of superior mesenterc artery (SMA)** must be anticipated . Injury to **proximal SMA** is repaired with interposition graft or patch angioplasty using saphenous vein or prosthetic material to prevent ischemic loss of entire bowel. In injury to **distal SMA**, there is no need for vascular repair as it causes only segmental ischemia.The affected segment of bowel is resected and entero-enterostomy done.

COMPLICATIONS:

Hemorrhage, wound infection, post operative adhesions.

COLONIC INJURIES

The colon is relatively refractory to blunt trauma . signs and symptoms are not specific for injury to the colon. Indirectly it will cause peritoneal irritation and tenderness. Laboratory studies are not helpful. Radiological studies may show free air.

DPL is of value if intraperitoneal colonic injury is present.

Whenever possibility of colonic injuries is entertained , prophylactic antibiotis should be started.

COLONIC INJURIES SCALE

GRADE	INJURY	DESCRIPTION
I	Haematoma	Contusion or hematoma without devascularisation
	Laceration	Partial thickness , no perforation
II	Laceration	Laceration < 50% of circumference
III	Laceration	Laceration > 50% of circumference Without transection
IV	Laceration	Transection of colon
V	Laceration	Transection of colon with segmental tissue loss

SURGICAL OPTIONS IN MANAGEMENT OF COLONIC INJURIES

1. primary closure without colostomy
2. primary colostomy with or without repair or exteriorization
3. resection and anastomosis
4. exteriorised primary repair

Primary repair can be selected when known associated complicating factors are excluded

. The ***risk factors*** being

- ► preoperative hypotension – intraperitoneal haemorrage > 1 litre
- ► more than 2 associated organs injured
- ► significant faecal soilage
- ► > 6 hours after injury , > 6 units of blood transfused
- ► colonic vascular injury
- ► injury not limited to one aspect of colon

Colostomy is not justified expect in

1. late case with established sepsis
2. tenuous blood supply to a repair
3. unstable patients
4. patients who require packing for bleeding or DIC

RECTAL INJURIES

This should be **suspected when** there is sacral fracture that produces pelvic ring

disruption or any penetrating injury involving the perineum.

RECTUM INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Haematoma	Contusion or hematoma without devascularisation
	Laceration	Partial thickness , no perforation
II	Laceration	Laceration < 50% of circumference
III	Laceration	Laceration > 50% of circumference Without transection
IV	Laceration	Full thickness laceration with extension into the perineum
V	Laceration	Devascularised segment

PRINCIPLES OF OPERATIVE MANAGEMENT

- ► Placement of patient in lithotomy position
- ► wide debridement of all dead and devitalized tissue
- ► a totally defunctioning colostomy
- ► adequate rectal drainage
- ► distal rectal stump washout

Complete rectal destruction is an indication for primary Abdomino – Perineal excision.

Complications

Pelvic abscess , urinary / rectal fistulae , urinary / rectal incontinence ,

rectal stricture , loss of sexual function

MESOCOLON INJURIES

Simple , non expanding hematomas can be left undisturbed. Large hematomas which are expanding are explored without any vascular compromise to the colon.

GREATER OMENTUM INJURIES

Rarely hematomas are encountered. Simple evacuation is all that required. Extensive hematomas along the greater curvature can be excised with greater omentum without any compromise to the blood supply of the stomach.

RETROPERITONEAL HAEMATOMA

The optimum management of RPH **depends on** etiology , location and presence of associated injuries.

- **zone I : central RPH** - are associated with major vascular or pancreatico-duodenal injuries
- **zone II : flank or perinephric lateral hematomas** are associated with injuries to the genito-urinary tract.
- **zone III : originate in pelvis** , are associated with pelvic fractures.

UROLOGICAL TRAUMA

Renal trauma

Renal injuries may be classified as major or minor

Minor injuries : simple laceration,subcapsular hematoma, renal contusion.

Major injuries : renal rupture , laceration of renal vessels, perirenal hematoma , laceration through collecting system

DIAGNOSIS

May be suspected in an individual with gross or microscopic hematuria , a history of injury to flanks , a bruise over the flank and fractured ribs posteriorly in x-rays

KIDNEY INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Contusion	Microscopic/gross hematuria, normal – uro studies
	Hematoma	Subcapsular non-expanding hematoma without parenchymal Laceration
II	Hematoma	non-expanding peri-renal hematoma
	Laceration	< 1 cm depth parenchymal – cortex without urinary extravasation
III	Laceration	> 1 cm depth parenchymal – cortex without urinary extravasation , collecting system rupture
IV	Laceration	parenchymal Laceration thro parenchymal cortex,medulla,collecting system
	Vascular	Main reanl artery / vein injury with contained bleed
V	Laceration	Completely shattered kidney
	Vascular	Avulsion of renal hilum with renal devascularisation

INVESTIGATIONS

Urine analysis, excretory urography, renal sonography,

Differential isotope scan, CT scan, Angiography

MANAGEMENT

In contrast to the policy of surgically exploring patients with penetrating renal injuries, most patients with blunt trauma can be observed.

Selection of patients for operative treatment should be based on the overall clinical status and necessity of surgical repair or resection

The **aim of surgery** is to stop bleeding while conserving as much renal tissue as possible. A key operative technique is the proximal control of renal pedicle before opening Gerota's fascia in any circumstances of renal trauma.

The **approach to kidney** should be transperitoneal to exclude the possibility of damage to other abdominal organs.

Surgical options -

1. when the kidney is avulsed / ruptured from its pedicle – nephrectomy
2. small tears – sutured over hemostatic sponge
3. large single rents – suture renal tissue around nephrostomy tube
4. laceration confined to one pole – partial nephrectomy

when a solitary kidney is damaged it should be repaired. Failing this the wound should be packed firmly with gauze to stop the bleeding in the hope that some renal function may be retained when the ruptured kidney heals.

Complications of renal injury :

1. heavy hematuria
2. pararenal pseudo-hydronephrosis
3. hypertension
4. aneurysm of renal artery
5. peri-renal abscess

URETERIC INJURIES

The ureter is rarely injured in abdominal trauma. It is well protected by its mobility and location. Some **major considerations** apply in deciding the management

1. site (upper / middle / lower)
2. nature (blunt / penetrating)
3. time of recognition

immediately recognized - repair , stenting , proximal diversion

delayed recognision - drainage and diversion & later reconstruction

URETERIC INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hematoma	Contusion / hematoma without devascularisation
II	Laceration	< 50 % transection
III	Laceration	> 50 % transection
IV	Laceration	Complete transaction with < 2 cm devascularization
V	Laceration	Avulsion with > 2 cm devascularization

PRINCIPLES OF URETERIC REPAIR

Adequate debridement , tension free repair , spatulated anastomosis , water tight closure , ureteral stenting , drainage

1. **uretero-ureterostomy** : preferred in upper/middle thirds , longitudinal spatulation with 5-0 chromic interrupted sutures over a silastic stent with urinary diversion .

2. **intramural / lower ureteric defects** - ureteric reimplantation with

tunneled techniques preferable.

3. **> 7 cm destruction** – mobilization of kidney and bladder allows ends approximation. A psoas bladder hitch may help to decrease tension on suture line.

4. **longer ureteric gap** – a submucosal implantation into a Boari bladder flap.

5. **massive destruction of lower ureter** – trans-ureteroureterostomy

6. **total destruction** – segment of ileum is substituted.

7. **extensive loss in upper third** – auto transplantation of kidney in iliac-fossa .

BLADDER INJURIES

Intraperitoneal rupture:

Suspected in cases with sudden deceleration injury , lower abdominal tenderness , hematuria, inability to void. A cystogram will establish the diagnosis . The bladder is closed in 2 layers absorbable sutures with suprapubic urinary diversion.

10-14 days after , a cystogram is done through SPC tube and a post evacuation film is taken , if there is no extravasation and if the patient can void without residual urine the SPC is removed.

Extra peritoneal rupture:

Commonly associated with pelvic fracture. Surgical exploration,debridement of devitalized tissue, repair in layers , draining the bladder with Foley's urethral catheter and a drain in retropubic / pre-vesical space.

BLADDER INJURY SCALE

GRADE	INJURY	DESCRIPTION
I	Hematoma	Contusion / intramural hematoma
	Laceration	Partial thickness
II	Laceration	Extraperitoneal wall laceration < 2 cm
III	Laceration	Extraperitoneal wall laceration < 2 cm / intraperitoneal wall laceration < 2 cm
IV	Laceration	intraperitoneal wall laceration > 2 cm
V	Laceration	Intra / extraperitoneal wall laceration extending into bladder neck or ureteral orifice (trigone)

ABDOMINAL VASCULAR INJURIES

Abdominal vascular trauma **presents** ~~eith~~er as free intraabdominal haemorrage or as contained retroperitoneal hematoma

Failure to maintain a stable BP in spite of vigorous resuscitation points to continued bleeding and is an **indication for emergency surgery**.

Laparotomy is performed through midline incision . Rapid evacuation of collected blood enables quick assessment of injury sites. Free haemorrage is controlled with finger pressure and packing. If the bleed cannot be

controlled by packing, aortic cross clamping can be done as an adjunct.

AORTIC CROSS CLAMPING CAN BE DONE AT :

- Descending thoracic aorta through a left anterolateral thoracotomy
- Supra celiac aorta can be clamped at through the lesser sac
    1. after exposure by MATTOX MANOEUVRE where pancreas , spleen and left colon are mobilized and pushed to the right side
    2. supra renal aortic cross clamping can be done either through mattox manoeuvre or through extended KOCKER maneuver
    3. infra aortic cross clamping can be exposed beneath left renal vein

Aortic cross clamping can cause an elevation in cardiac after load, distal ischemia and metabolic acidosis. Hence clamping should be released as early as possible after control of bleeding.

TREATMENT OF ABDOMINAL INJURIES

Medical therapy

The initial goal of paramedics with Advanced Trauma Life Support training is to rapidly **assess** the patient's airway with cervical spine precautions, breathing, and circulation. This is then **followed by** splinting of fractures and control of external hemorrhage. The injured patient is at risk for progressive deterioration from continued

bleeding and requires **rapid transport** to a trauma center or the closest and most appropriate facility, with appropriate stabilization procedures performed en route. Hence, securing the airway, placing large-bore intravenous lines, and administering intravenous fluid must take place en route, unless delays in transport occur, for instance, if prolonged extrication is required.

Upon arrival **at the ED or trauma center**, the first priority is reassessment of the **airway**. Protection of the cervical spine with in-line immobilization is absolutely mandatory. If intubation is indicated, attempt nasotracheal (ie, if no contraindications) or endotracheal intubation. If unsuccessful, perform cricothyroidotomy. After an airway has been established, adequate ventilatory exchange is assessed by auscultation of both lung fields.Clinical diagnosis of a tension pneumothorax is treated with needle decompression followed by chest thoracostomy tube placement. Other mechanical factors that can interfere with ventilation include sucking chest wounds, a hemothorax, and pulmonary contusion. Treat these aggressively and expediently.

The next priority in the primary survey is an assessment of the **circulatory status**

of the patient. Circulatory collapse in a patient with BAT is usually caused by hypovolemia from hemorrhage. Effective volume resuscitation is accomplished by controlling external hemorrhage and infusing warmed crystalloid solution via 2 large-bore peripheral IV lines. Hemodynamic instability despite the administration of 2 L of fluid to adult patients indicates ongoing blood loss and is an indication for immediate blood transfusion. Administer type O, -negative blood if cross-matched or type-specific blood is not available.

The primary survey is completed with a brief **neurologic assessment** using the Glasgow Coma Scale. The patient is undressed and draped in clean, dry, warm sheets.

The **secondary survey** consists of a complete and thorough physical examination

Nonoperative management of BAT

Nonoperative management **strategies based on** CT scan diagnosis and the hemodynamic stability of the patient are now being used in the treatment of adult solid organ injury, primarily the liver and spleen. In BAT, including severe solid organ injuries, selective nonoperative management has become the standard of care.

Angiography is a valuable modality in the nonoperative management of adult

abdominal solid organ injuries from blunt trauma. It is used aggressively for non – operative control of hemorrhage, thus avoiding non-therapeutic laparotomies.

SURGICAL THERAPY

ED resuscitative thoracotomy is only occasionally life-saving. It is an aggressive, desperate measure to save a patient in whom death is thought to be imminent or otherwise inevitable. Survival with good neurologic recovery is more likely for patients with penetrating trauma than patients with blunt trauma. Thoracotomy may have a **role in** selected patients with penetrating injuries to the neck, chest, or extremities and those with signs of life within 5 minutes of arrival to the ED.

A resuscitative thoracotomy is seldom of benefit for patients with cardiac arrest secondary to blunt or head injury or for those without vital signs at the scene of the accident. Patients with blunt thoracoabdominal trauma with pulseless electrical activity upon ED arrival have a survival rate of virtually 0% and are poor candidates for resuscitative thoracotomy. Blunt trauma patients may be allowed an ED thoracotomy only if they have signs of life upon arrival to the ED.

In a patient with hemoperitoneum from blunt thoracoabdominal trauma, the purpose of an ED resuscitative thoracotomy **is** (1) to cross-clamp the aorta, diverting available blood to the coronaries and cerebral vessels during resuscitation; (2) to evacuate pericardial tamponade; (3) to directly control thoracic hemorrhage; and (4) to open the chest for cardiac massage.

Indications for laparotomy

in a patient with blunt abdominal injury include

Signs of peritonitis, uncontrolled shock or hemorrhage, clinical deterioration during observation, and hemoperitoneum findings after FAST or DPL examinations

Broad-spectrum antibiotics are given. A midline incision is preferred. Abdomen is opened, hemorrhage control is accomplished by removing blood and clots, packing all 4 quadrants, and clamping bleeders. Obvious hollow viscus injuries are sutured.

After intra-abdominal injuries have been repaired and hemorrhage has been controlled by packing, a **thorough exploration of the abdomen** is then performed to evaluate the entire contents of the abdomen.

After intraperitoneal injuries are controlled, the retroperitoneum and pelvis must be inspected. **Do not** explore pelvic hematomas. Use external fixation of pelvic fractures to reduce or stop blood loss in this region.

Explore large or expanding midline retroperitoneal hematomas, with the anticipation of damage to the large vascular structures, pancreas, or duodenum. **Do not** explore small or stable perinephric hematomas.

After the source of bleeding has been stopped, further stabilizing the patient with fluid resuscitation and appropriate warming is important.

After such measures are complete, perform a thorough exploratory laparotomy with the appropriate repair of all injured structures.

Postoperative details:

Patients who had gross enteric contamination of the peritoneal cavity are given appropriate antibiotics for 5-7 days.

If a pelvic hematoma was found and the patient continues to lose blood after external fixation of a pelvic fracture, arteriography with embolization can be used to stop the small percentage of arterial bleeding found in pelvic fractures.

Follow-up care:

The trend to just observe hemodynamically stable patients with injuries involving the spleen, liver, or kidneys is becoming more popular. In one study of pediatric patients, those with BAT who were hemodynamically stable after less than 40 mL/kg fluid replacement, had proven evidence of solid organ injuries, and remained stable were admitted to the pediatric intensive care unit under surgical management.No deaths and no immediate or long-term complications were reported in this group.

If the decision has been made to observe the patient,

closely monitor vital signs and frequently repeat the physical examination. An increased temperature or respiratory rate can indicate a viscus perforation or abscess formation. Pulse and blood pressure can also change with sepsis or intra-abdominal bleeding. The development of peritonitis based on physical examination findings is an indication for surgical intervention.

COMPLICATIONS OF ABDOMINAL TRAUMA

Complications associated with AT include but are not limited to the following:

- Missed injuries
- Delay in diagnosis
- Delay in treatment
- Iatrogenic injuries
- Intra-abdominal sepsis and abscess
- Inadequate resuscitation
- Delayed splenic rupture

Observation and Discussion

OBSERVATION AND DISCUSSION

In this present study conducted in emergency dept. from 1.1.04 to 10.03.06,

- **For blunt abdominal injuries** - history , clinical examination and serial physical periodic evaluation played a major role in decision making..
- **For penetrating injuries -** in stable cases, the wound is explored locally and if it was found to be muscle deep without any breach in peritoneum – the cases were managed conservatively and are kept under close observation.
- **Diagnostic peritoneocentesis is performed in all doubtful cases.**

Ultrasound and CT scans are less used due to their non-availability on 24 hrs basis.

As a policy, in all cases with hemodynamic instability , haemoperitoneum, features of overt peritonitis, significant evisceration – **immediate laparotomy** is performed after rapid initial resuscitation.

The **specific parameters** are recorded in each case taken up for laparotomy and are evaluated for individual and combined usefulness in decision making. Those patients who are managed conservatively are **excluded from this study**.

Of the total 61 cases operated, 51 were males and remaining 10 were females. 51 cases were due to blunt injuries and 10 cases were due to penetrating injuries.

Out of the 51 blunt abdominal, most of the cases were due to RTA, which account for 40 cases. In the remaining, 3 cases were due to kicks and blows and 3 cases were due to fall from height and 5 cases were due to blunt assault to the abdomen.

Out of the 10 penetrating injuries , 7 cases were due to stab injury, which is the commonest cause , followed by 1 case due to RTA, and 1 case was due to self inflicted wound in a suicidal attempt,1 case was due to bull gore injury. The site of entry in most of the cases were in epigastrium (4),followed by 1 case in Rt. Hypochondrium,3 cases in peri-umbilical , 1 in perineum and 1 in the Lt.iliac region

Road traffic accident was the most common cause for the blunt Injury (78.4%). Stab injury was the commonest cause for penetrating abdominal injury (70%).

In the present study the highest incidence of abdominal injuries was due to blunt abdominal trauma which was also observed by Gregory et al. The maximum age incidence

was in the group of 20 – 40 yrs (61%) . This was also observed in other studies,(Mahajana and Aboud et al , James et al).

A study conducted at Missisippi Medical Center by James et al found that 78 % were in the age group of 18 and 40 years . It was suggested that , because a more active life in that age group , these age groups were involved.

COMPARISON OF AGE INCIDENCE IN ABDOMINAL TRAUMA

Age incidence	James et al		Present study	
	No of cases	Percentage	No of cases	Percentage
0 – 20	18	11.6	14	22.9
21 – 30	81	52.3	19	31.1
31 – 40	40	26	18	29.5
41 – 50	12	7.7	6	9.8
51 & above	4	2.6	4	6.5

COMPARISON OF SEX INCIDENCE IN ABDOMINAL TRAUMA

Case study	Male		Female	
	No of cases	percentage	No of cases	percentage
Jolly et al	84	84	16	16
CURRENT STUDY	51	83.6	10	16.3

In our study males were commonly involved than females (5.1 : 1).In the study conducted by Jolly et al , they also found that males were commonly affected (4:1) , because of their more outdoor activity which is also observed by Dent et al.

COMPARISON OF ETIOLOGY IN BLUNT ABDOMINAL TRAUMA

Mode of injury	Jolly et al	Divincenti et al	**CURRENT STUDY**
RTA	43 %	74 %	78.4%
Assault	29 %	14 %	15.7 %
Fall	23 %	9 %	5.8 %

Road traffic accident accounts for most of the blunt abdominal trauma (78.4%). Which was also observed in other studies - Jolly et al., and Divincenti et al.

In the pattern of penetrating injuries, stab injury constituted the most important mechanism (70%).But in western studies gun shot wounds account for most of the cases. This was mainly due to cultural differences and rarity of possessing guns in our country.

INCIDENCE OF SPECIFIC ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA

The most common organ involved after blunt abdominal trauma was spleen (37%). In the study conducted by Baisdell and Trunkey et al -spleen was involved in 25% of cases which was also observed by other authors [Moosa et al , Brown and Casola et al , Parithivel and Sajja et al]

In two cases of blunt trauma in laparotomy no specific organ of injury was noted (negative or non-therapeutic laparotomy rate – 3.9 %)

ORGANS INJURED	Blaisdel and Trunkey et al	CURRENT STUDY
SPLEEN	25 %	19 / 51 : 37.25 %
LIVER	15 %	6 / 51 : 11.8 %
SMALL INT..	12 %	8 / 51 : 15.6 %
OMENTUM	-	1 / 51 : 1.9 %
MESENTRY	5 %	5 / 51 : 9.8 %
LARGE INT.	-	5 / 51 : 9.8 %
MESOCOLON	-	1 / 51 : 1.9 %
BLADDER	6 %	12 / 51 : 23.5 %
R P H	13 %	5 / 51 : 9.8 %
NO SPECIFIC IRGAN	-	2 / 51 : 3.9 %

INCIDENCE OF SPECIFIC ORGAN INJURY IN PENETRATING ABDOMINAL TRAUMA

In penetrating abdominal trauma , small intestine was the most common organ involved in our study (30%). In some studies liver was the most commonly involved organ (Hoyt et al , Moosa et al, Beader et al , Brammer et al) and in some other studies small bowel was the commonly involved organ (Bentaub et al , Nichola and Rix et al , Glezer et al). The differences observed are due to the type of weapon used.

ORGANS INJURED	HOYT et al	CURRENT STUDY
SPLEEN	-	10 %
LIVER	37 %	10 %
SMALL INT..	26 %	30 %
OMENTUM	5 %	70 %
MESENTRY	5 %	30 %
LARGE INT.	17 %	20 %
MESOCOLON	-	10 %
STOMACH	19 %	20 %

Specific organ injury

SPLENIC INJURIES

IN our study **20 cases** of splenic injury have been observed. In all our cases splenectomy was performed , due to ongoing bleed from injured organ of severe grades. Splenic conservation was not attempted.13 cases presented with hemodynamic instability. Rib fractures in **plain x-ray** is seen in 8 (20%)cases

DPC was done in all cases and was positive in 17 (85%) cases. In stable patients **Ultrasound** was done 4 cases were positive in 6 cases done (67%). **CT scans** were done in 7 cases and 6 cases splenic injury was observed (85.7% predictive value).

LIVER INJURIES

Liver was injured in **7 cases** in our study. 5 cases presented with hemodynamic instability . **DPC** was performed in all cases & was positive for blood in 5 (71.4%) cases. In stable cases **Ultrasound** revealed free fluid in 1 out of 3 (33%) of cases performed . **CT scan** revealed liver injuries in 2 out of 3 cases performed (66%). Most of our liver injuries are of grade I & II injuries which was also observed by Britt et al in their study. Gelfoam packing was done for grade II injuries **in 6 cases** and **in 2 cases** electro-coagulation and suturing of the laceration with vicryl was done.. For the **one** grade III injury perihepatic packing was done and there was no active bleeding. This methodology of management has been shown to be effective in other western studies (Marr et al , Caruso et al , Parks and Chrysos et al) also.

SMALL BOWEL INJURIES

Of the **11 cases** of small bowel injury , 6 cases were due to jejunal perforations and 5 cases due to ileal perforations. In treating penetrating injuries it should be noted that , the total number of bowel injuries should be multiplies of two , which insist careful examination of the whole gut during the laparotomy. Out of the 11 cases . **8 cases** showed **air under diaphragm** (72.7%). In the study conducted by koul et al they found that 33% cases showed pneumoperitoneum. The sign of pneumoperitoneum is not reliable. **DPC** revealed aspiration of bowel effluents in 3 out of 8 cases (37.5%). **Ultrasound** revealed free fluid in 3 out of 6 cases done

(50%) . **CT scan** was performed in the 3 cases and was not useful in any of the cases.

For one thro and thro laceration of proximal jejunum in blunt injury , resection and anastomosis was performed in 2 layers. In all other remaining cases primary repair in two layers was performed.

The **role of DPL** is questionable since WBC count is not standardized in penetrating injuries. Due to their over sensitivity DPL can cause more unnecessary Laparotomies (Driscoll et al) . **CT** may not identify intestinal trauma because subtle changes in like bowel wall thickness , periviseral fluid collections and small pockets of free air can only be visuvalised with increasing trend towards conservative management of solid injuries there is 30 % chance of missing small bowel injuries(Knudson et al).

GASTRIC INJURIES

In our study there were **2 cases**. Of this 1 case was due to penetrating trauma and 1 case due to blunt abdominal trauma. Blaisdel et al in their study found that penetrating injuries was the most common mechanism for gastric injuries . Both cases perforation occurred in anterior wall of stomach with no posterior penetration. In all cases the body of stomach was involved. In all the cases wounds were managed by 2 layer primary repair with naso-gastric tube decompression. In one case there was an associated diaphragmatic injury on left side. **Both cases** showed air under diaphragm. **Diagnosis was suspected** due to pattern of injury and physical

examination.

COLONIC INJURIES

In our study there were **4 cases** of colonic injuries , of which one case was due to penetrating injury and other 3 cases due to blunt injury. In the penetrating injury to sigmoid colon , defect was repaired primarily with diversion colostomy. The current trend favors primary colonic repair , if there is no adverse effects (Oshodi and Bowrey et al). The bluntly injured sigmoid colon was exteriorized due to late presentation and fecal peritonitis , after 6 weeks colostomy closure was performed. **All radiological studis were not useful** in diagnosing these injuries. **High degree of clinical suspicion was required for early diagnosis.**

RECTAL INJURIES

There were **3 cases** of rectal injuries in our study , 1 was due to a penetrating injury due to bull gore involving the perineum. The patient had associated vaginal vault tear with urethral tear involving external meatus. The wound was explored and rectal lateral wall injury was found So a protective colostomy is performed and suprapubic urinary diversion with primary repair of meatus and vault was done. Small , isolated rectal or rectosigmoid perforations were repaired primarily (Ivatury et al). Other two cases due to blunt trauma – RTA involving paragluteal region which were repaired in single layer interrupted sutures with proximal colostomy.

DIAPHRAGMATIC INJURIES

In our study only **one case** due to stab injury was observed. The defect was repaired with non-absorbable sutures with ICD. A **high degree of suspicion** was required for its diagnosis (Haciibrahimoglu et al)

MESENTERIC INJURIES

In our study , there were **8 mesenteric injuries** encountered, 5 cases were due to blunt and 3 cases due to penetrating injuries.of the blunt injuries , 1 had contusion near root of mesentery without hematoma ,2 had contusion near proximal jejunam with non expanding hematoma, 2 had a linear tear which was sutured. All 3 cases with penetrating injuries had linear tears with adjacent bowel injuries in two cases. **Radiological studies were inconclusive and only clinical suspicion was useful**.

MESOCOLON INJURIES

In our study there were **2 mesocolon injuries** , out of which 1 was due to blunt and 1case due to penetrating injury near sigmoid mesocolon which is repaired primarily. That due to blunt injury was near transverse mesocolon with non-expanding retroperitoneal hematoma which was manages conservatively. A mesocolic injury cannot be ruled out even with a negative **CT scan** (Nolan et al).

OMENTAL INJURIES

Total cases 8, with **7 cases** due to penetrating injuries and 1 due to blunt trauma. These injuries were repaired primarily with hemostasis.

RETROPERITONEAL HAEMORRAGE

Total of **5 cases** of RPH were found in our study . All were due to blunt injuries with contusion to the mesentery , sigmoid,transverse and ascending colon . The retroperitoneal haemorrage was treated conservatively as they were of non-expanding zone II hematomas. **DPC , ultrasound** (0%) were not useful . **CT scan** (33%) was useful in the diagnosis

KIDNEY AND BLADDER INJURIES

There were **2 cases** of grade 1 renal injury due to blunt trauma , which was managed conservatively. **12 cases of bladder injuries** were encountered. In 4 cases intra-peritoneal rupture near trigone - which was repaired primarily in two layers with SPC cystostomy . In other cases there were prevesical hematoma only- which was managed conservatively **. DPC** (50%) , **Ultrasound** (62%) , **CT scan** (100%) **aided in diagnosis**.

EVALUATION OF DIAGNOSTIC PARAMETERS IN SPECIFIC ORGAN INJURIES

ORGANS	cases	Tach.	Hypo.	Pall.	U/O	Tend.	Guar.	DPC	X-ray	USG	CT
Spleen	20	19 95%	13 65%	18 90%	3 15%	11 55%	5 10%	17 85%	8 40%	4/6 67%	6/7 86%
Liver	7	7 100%	5 71%	7 100%	1 14%	5 71%	0 0%	5 71%	4 57%	1/3 33%	2/3 66%
Small int	11	9 82%	1 9%	1 9%	4 36%	11 100%	8 72%	3 33%	8 72%	3/6 50%	0/3 0%
Large int	7	6 86%	1 14%	1 14%	1 14%	6 86%	3 43%	1 14%	1 14%	1/4 25%	1/1 100%
Omentum Mesentery Mesocolon	14	11 78.5%	0	2 12%	0	13 93%	8 57%	5 38%	0	4/8 50%	0/3 0%
Bladder	12	5 42%	0	0	9 75%	10 83%	4 33%	6 50%	9 75%	5/8 62%	3/3 100%
RPH	5	4 80%	1 20%	1 20%	1 20%	3 60%	2 40%	0	2 40%	0/3 0%	1/3 33%
Overall	61	53 87%	21 34%	29 48%	21 34%	48 79%	10 16%	34 56%	34 56%	15/28 54%	13/18 72%

CLINICAL PARAMETERS

TACHYCARDIA

In our present study , tachycardia was observed in most of the cases [**53/61=87%**].

It was also observed that it was positive in most of the specific organ injuries and **was not specific to any of the specific organ injured**

SPLEEN	LIVER	SMALL INT.	LARGE INT.	OMENTUM MESENTRY MESOCOLON	BLADDER	RPH	OVERALL
19/10 **95%**	7/7 **100%**	9/11 **82%**	6/7 **86%**	11/14 **78.5%**	5/12 **42%**	4/5 **80%**	53/61 **87%**

HYPOTENSION

In our study shock was observed in 21 out of 61 cases i.e. 34% of overall cases.

And it was found to be mostly **specific for solid organ injuries** like

Spleen (65%), liver(71%), RPH (20%).

SPLEEN	LIVER	SMALL INT.	LARGE INT.	OMENTUM MESENTRY MESOCOLON	BLADDER	RPH	OVERALL
19/20 **95%**	7/7 **100%**	9/11 **82%**	6/7 **86%**	11/14 **78.5%**	5/12 **42%**	4/5 **80%**	53/61 **87%**

PALLOR

In our present study pallor was observed in 29 Out of 61 cases (**48%**). It was

found to be more **specific for solid organ injuries** associated with blood loss.

SPLEEN	LIVER	SMALL INT.	LARGE INT.	OMENTUM MESENTRY MESOCOLON	BLADDER	RPH	OVERALL
18 / 20	**7 / 7**	**1 / 11**	**1 / 7**	**2 / 14**	**0 / 12**	**1 / 5**	**29 / 61**
90%	**100%**	**9%**	**14%**	**12%**	**0%**	**20%**	**48%**

<u>URINE OUTPUT</u> (oliguria / hematuria)]

In our study , oliguria was observed in 21 out of 61 cases (**34%**) . And was not specific to any organ injury. But **hematuria** was seen in 9 out of 12 i.e. 75% of bladder injuries.

SPLEEN	LIVER	SMALL INT.	LARGE INT.	OMENTUM MESENTRY MESOCOLON	BLADDER (**HEMATURIA**)	RPH	OVERALL
3/20	1/7	4/11	1/7	0/14	9/12	1/5	21/61
15%	**14%**	**36%**	**14%**	**0%**	**75%**	**20%**	**34%**

<u>TENDERNESS</u>

In the present study , this was observed in 48 out of 61 cases (79%). And was noted that in most of the specific organs involved – that **specific quadrant** was involved.

SPLEE	LIVE	SMAL	LARG	OMENTUM MESENTRY	BLADDE	RPH	OVERAL

N	R	L INT.	E INT.	MESOCOLON	R		L
11/20	5/7	11/11	6/7	13/14	10/12	3/5	48/61
55%	**71%**	**100%**	**86%**	**93%**	**83%**	**60%**	**79%**

GUARDING

In our study this was observed in 10 out of 61 cases (16%). This was observed in **injuries to bowel after the setting in of peritonitis and was a late sign**.

SPLEEN	LIVER	SMALL INT	LARGE INT	OMENTUM MESENTRY MESOCOLON	BLADDER	RPH	OVERALL
5/20	0/7	8/11	3/7	8/14	4/12	2/5	10/61
10%	**0%**	**72%**	**43%**	**57%**	**33%**	**40%**	**16%**

DIAGNOSTIC PERITONEO CENTESIS (DPC)

In our present study , DPC was grossly positive for blood / bowel effluents in 34 out of 61 cases (**51%**). DPC was **found to be specific to** both solid (blood), bowel (condents) injuries and was **not so sensitive in** injuries to omentum, mesentery, RPH. **False positive** in 1 case (1/61 = 1.6 %).

Spleen	Liver	Small int	Large int	Omentum Mesentry Mesocolon	Bladder	RPH	OVERALL
17/20	5/7	3/11	1/7	5/14	6/12	0/5	34/61
85%	**71%**	**33%**	**14%**	**38%**	**50%**	**0%**	**56%**

X RAYS

In our study , positive findings were noted in 34 out of 61 **overall** cases (**56%**). The findings like **pneumoperitoneum** were seen in stomach, small/large bowel injuries(8/11=72%). **Pelvic fractures** seen in bladder injuries (9/12=75%).

Rib fractures were associated with spleen (8/20=40%) , liver (4/7=57%) injuries.

Spleen	Liver	Small int	Large int	Omentum Mesentry Mesocolon	Bladder	RPH	OVERALL
8/20	4/7	8/11	1/7	0/14	9/12	2/5	34/61
40%	**57%**	**72%**	**14%**	**0%**	**75%**	**40%**	**56%**

ULTRASOUND

This was **performed only in stable doubtful cases** and was positive in 15 out of 28 cases done i.e.**54%** of performed cases. **Specific organ of injury was not usually diagnosed** . **Free fluid** was observed in most of the cases. Spleen (4/6 : 67%) , small bowel (3 /6 : 50 %), Bladder (5 / 8 : 62 %) injuries**.**

Spleen	Liver	Small int	Large int	Omentum Mesentry Mesocolon	Bladder	RPH	OVERALL
4/6	1/3	3/6	¼	4/8	5/8	0/3	15/28
67%	**33%**	**50%**	**25%**	**50%**	**62%**	**0%**	**54%**

CT SCAN

This also was **performed only in** hemodynamically stable , doubtful cases. It was observed positive in **detecting specific injuries** in 13 out of 18 cases performed (72%). Specific organ injury is diagnosed with **great accuracy in** spleen , liver, bladder, renal injuries. CT scan **was the only option available to diagnose RPH preoperatively**. With the use of CT **many of the non-therapeutic laparotomies can be avoided.**

Spleen	Liver	Small int	Large int	Omentum Mesentry Mesocolon	Bladder	RPH	OVERALL
6/7	2/3	0/3	1/1	0/3	3/3	1/3	13/18
86%	**66%**	**0%**	**100%**	**0%**	**100%**	**33%**	**72%**

Conclusion

CONCLUSION

► The **incidence** of blunt trauma is higher than penetrating abdominal trauma

► Road traffic accidents ranks first as the **cause** of blunt abdominal trauma.

Stab injury with knife is the most common cause of penetrating abdominal trauma.

► The incidence in **males** is higher than in females,

The highest incidence is found in the **age group** 20 – 40 years.

► Spleen is the most common **organ involved** in blunt abdominal trauma

Small bowel, mesentery are most commonly involved in penetrating trauma

► **Initial and serial physical examination including Diagnostic Peritoneo-Centesis** has the main role in decision making concerned with operative intervention in traumatic abdominal emergencies.

► **Specialized investigations like ULTRASOUND and CT SCAN** have limited role in decision making concerned with operative intervention in traumatic abdominal emergencies. These are **performed in** selected cases only and **can be useful in** confirming clinical diagnosis, diagnosis of specific organ injuries and deciding non – operative management.

Summary

SUMMARY

IN OUR STUDY , most of the cases are operated on the basis of physical findings alone and repeated serial clinical examination of the patient. **In our setup and in other developing countries** - correct interpretation of **physical findings**, timely intervention will be more useful for the poorer patients than asking for adjunctive studies which have their own limitations.

Diagnostic modality if available should compliment the physical examination.

In DPL its oversensitivity, lack of organ specificity , failure to detect retroperitoneal

and diaphragmatic injuries are main drawbacks. Its useful in detecting hemoperitoneum , bowel injuries.

For Ultrasound it needs a minimum of 70 ml of intraperitoneal fluid for a positive study which may not be there at initial stage.there is also 25% incidence of failure in detecting splenic and liver injuies.

CT scan requires oral / i.v. contrast , stable patient , specialized person to interpret findings. It is not reliable in detecting GI injuries. Useful in detecting retroperitoneal , renal , pancreatic injuries . Specific solid organ injury is diagnosed with great accuracy . Useful in grading , deciding non-operative management.

Technology will always be just a tool, whereas qualified surgeons are irreplaceable.

The **best approach to the patient with abdominal trauma** is simply to suspect the injury. **Diagnostic tests** should not be done with a sense of avoiding operations but with the objective of detecting injuries. The **key in treating abdominal injuries** is determining that an injury exists rather than determining exact nature of injury.

Observation, diagnosis and surgery are of course greatly facilitated by Ever-evolving technology.

Evaluating patients who have sustained abdominal trauma remains one of the

most challenging and resource-intensive aspects of acute trauma care. Missed intra-abdominal injuries continue to cause preventable deaths. **Physical examination findings** are notoriously unreliable for several reasons. A few examples are - the presence of distracting injuries, an altered mental state, drug and alcohol intoxication in the patient.

Coordinating a trauma resuscitation demands a thorough understanding of the patho-physiology of trauma and shock, excellent clinical and diagnostic acumen, skill with complex procedures, compassion, and the ability to think rationally in a chaotic milieu.

Proforma

PROFORMA - Abdominal trauma

1. **Name:** **Age:** **Sex:** **Income:**

   Address: **I.P. no:** **Occupation:**

2. **Time factors**

   Time of injury: Time of admission:

   Time of onset if symptom:

   Time of surgery: D.O.D:

3. **First aid given :** yes / no

4. **Conservative management:**

5. **Surgical management:**

6. **Level of consciousness on admission**

7. **Intoxicated :** yes / no

8. **Mode of injury:** **weapon used:**

9. **Primary management in peripheral hospital :**

10. **Site of injury**

    a. **Abdominal wall**

       Abrasion Laceration Ecchymosis Incised Others

    b. **Intra-abdominal**

       Solid Hollow-viscus Vascular

11. **Other system injury :**

12. **Associated bony injury :** pelvis spine long bones

13. **Whether passed urine / faeces after injury :**

14. **Vital clinical parameters:** **On admission - If changes any**

    Pulse:

    BP:

    Pallor

    Respiration:

    Temperature:

    Bowel sounds:

    Urinary output**:**
    (oliguria / Hematuria)

15. **Abdominal girth:** On admission - If changes any

16. Pain: site

type on coughing on percussion

increasing or decreasing shoulder tip pain

17. Vomiting: time of onset nature

18. Tenderness: site rebound

19. Guarding and rigidity: yes / no

20. Shifting dullness:

21: Perineal haematoma: yes / no

22. Naso gastric aspiration :

23. Bladder catheter specimen:

25. Details of blood transfusion:

26. Diagnostic Para-Centesis: positive / blood / bowel effluents

27. DPL: **-ve / +ve**

28. Culdocentesis:

29. Investigations (relevant):

Urine-sugar Blood- TC HB% PCV

Grouping and typing baseline Investigations

30. Plain X-ray abdomen : findings –

31. USG abdomen :

free fluid specific organ injury

32. CT SCAN : findings –

33. Expected line of management:

Purely conservative
Needs contrast observation and delayed surgery if indicated.
Purely surgical**.**

35. Laparotomy details – organs injured

Diaphragm	[ ]	Rectum	[ ]
Liver	[ ]	Bladder	[ ]
Spleen	[ ]	Urethera	[ ]
Stomach	[ ]	Mesocolon	[ ]
Small bowel	[ ]	Mesentry	[ ]
Colon	[ ]	Pancreas	[ ]
Omentum	[ ]	RPH	[ ]

Post operative period

Uneventful
Complicated
Nature of complication
Condition at Discharge

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Master Chart

KEY TO MASTER CHART

TACH – tachycardia

HYPO – hypotension

PALL – pallor

U / O - urinary output –

A – adequate , H – hematuria , O – oliguria

TEND – tenderness

GUARD – guarding

DPC - diagnostic peritoneo-centesis

X-RAY – plain x-rays

USG – ultrasonogram

CT – CT scan

<u>ORGANS INJURED</u>:

S – spleen , St. – stomach , L- liver, SI – small intestine ,

C – large intestine,M – mesentery , MC – mesocolon ,

O – omentum , D – diaphragm,

R - rectum , B – bladder , RPH – retro peritoneal hematoma .